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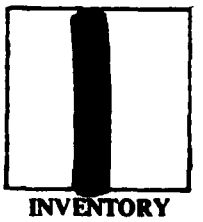

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SEMICONDUCTOR CCD MEMORY INSTEAD OF DRUMS AND DISKS

By

Z. Naotynski

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SEMICONDUCTOR CCD MEMORY INSTEAD OF DRUMS AND DISKS

Z. Naotynski

An integrated memory system CCD 465 based on charge coupled devices with capacity of 65,000 bits was designed recently by Fairchild. This is a significant step forward since until now only 9000 and 16,384 bits CCD systems were made. The purpose of this system is to create a large capacity memory, approaching that of drums and disks.

The advantages of a large semiconductor memory are their high speed, compactness, low power consumption, and the fact that no electromechanical components are involved. These are often a cause for breakage.

An effective competition with large memory systems with a rotating memory carrier (drums or disks) is very difficult because of the low cost per bit of recorded information (of the order of thousandths of a cent) characteristic of these systems. For this reason, the large semiconductor memories are realized with the cheapest of the known and practically applied technologies, namely the CCD, which technology is related to the MOS technology. From the principle of operation of CCD systems, it follows that it is easy to use them in a sequential dynamical memory application. The system described is made in the form of a circular memory based on a CCD shift register. The sequential access to recorded information, inherent for circular memories, is not a drawback in their application as a large memory system, since the drum and disk systems are also sequential in nature. The real disadvantage of semiconductor memories is their high price. It can be assumed that the continuous trend to enlarge the scale of integration, of which the CCD 465 is an example, will lead to lower costs and an effective competition with the electromechanical memories from the viewpoint of economy.

The new CCD[465] system has the SPS (series-parallel-serial) logical structure, characterized by a serial information input (bit after bit), parallel shift and serial information output. This structure was chosen since it is the most effective in applications to large serial memories. It ensures a low cost with high operation speed, high packing density, and low power consumption.

The integrated system described has 20 mm^2 area and contains a 64-bit input register, a basic shift register made of 16 parallel columns of 4096 bits, a 64 bit output register and peripheral circuits. Data enters the input register serially and after this is full, it is shifted into the 16 columns of the shift register. After transfer through the shift register it appears again serially at the output register.

The average access time to an arbitrary information bit is .5 msec at 4 MHz clock frequency, and in the extreme case it can reach 1 msec. This speed does not seem high as compared to memories with free access; however, it is comparable with speeds of drums and disks.

Another advantage is the lower power consumption. Operation in the mode write/read or write/modify/read requires 400 mW only, supplied by the usual four phase power supply at 4 MHz. A low power operation requires 70 mW at 1 MHz, while a fast searching consumes 300 mW at 4 MHz.

For general information about the capabilities of large semiconductor memory systems, we describe below a system based on the integrated CCD, INTEL 2416.

INTEL 2416 is a serial memory of 16,284 bits. It was introduced to the market at the beginning of 1975 at the price of $60 per chip. It contains 64 recirculating shift registers with 256 bit capacity each (6 bit addressable). The recirculation is automatic when a clock is connected. A shift takes place in all 64 registers simultaneously. INTEL 2416 is a CCD chip based on a high voltage MOS

gate located in an 18 terminal package. The maximum recording speed is 2 M bits/sec. An average access time is 100 microseconds at a frequency of 64 kHz, and 64 microseconds at 1 MHz. The supplied voltage is -12 V and +5 V. The dissipated power is 200 mW at maximum recording speed. The surface area is 20 mm^2.

One printed board of 1 million bit memory can operate as a small disk or drum system with maximum access time of 200 microseconds and a transfer speed of 2M bit/sec. It contains 64 integrated circuit INTEL 2416.

A larger memory system IN-65 is constructed of the integrated circuits 2416, and has a capacity of 18 million bits. It contains three types of printed boards of dimensions 370 x 305 mm; one driving board, one buffer, and 16 memory modules. Application of the CCD 465 devices in such a 65K system would reduce the number of modules from 16 to 4.

Prepared by Z. Noatynski
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From the publisher:

According to latest reports in the professional literature, in addition to Fairchild and Intel, Texas Instruments started to supply components for domain memories and semiconductor memories of the CCD type, which can be used to replace small drum and disk memories. There are TBM-0103 with 92,304 bits and TMS-3064 with a capacity of 65 K bits (for CCD memories).

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